

AD-A105 988

HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE
NATIONAL DAM SAFETY PROGRAM, LIPPS LAKE DAM (MO 30214), MISSISS-ETC(U)
OCT 80

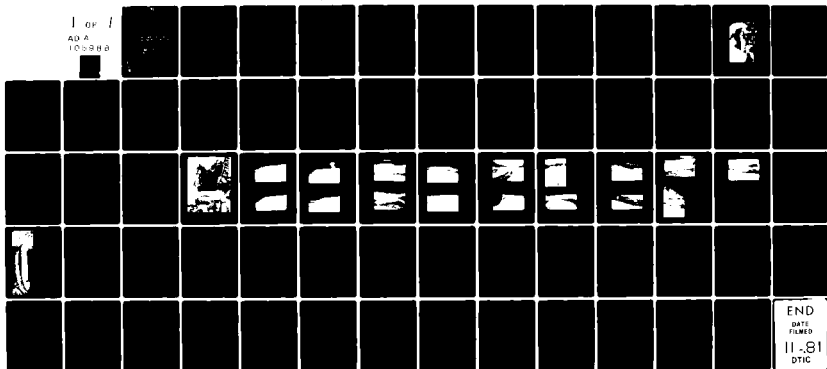
F/6 13/13

DACW43-61-C-0003

NL

UNCLASSIFIED

1 of 1
AD A
105988



END
DATE
FILMED
11-81
DTIC

LEVEL *71* *①*

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

LIPPS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 30214

AD A105988

6

**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**



**United States Army
Corps of Engineers**

*... Serving the Army
... Serving the Nation*

St. Louis District

**DTIC
ELEC
OCT 21 1981**

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

OCTOBER, 1980

This document has been approved
for public release and sale; its
distribution is unlimited.

ENC FILE COPY

10 10 19

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|--------------------------------------|--|
| 1. REPORT NUMBER | 2. GOVT ACCESSION NO. AD-A105-988 | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Lipps Dam (MO 30214) Cape Girardeau County, Missouri | | 5. TYPE OF REPORT & PERIOD COVERED Final Report |
| 7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc. | | 6. PERFORMING ORG. REPORT NUMBER |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSD-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101 | | 8. CONTRACT OR GRANT NUMBER(s) DACW43-81-C-0003 |
| 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSD-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) National Dam Safety Program. Lipps Lake Dam (MO 30214). Mississippi-Kaskaskia- St. Louis Basin, Cape Girardeau County, Missouri. Phase I Inspection Report. | | 12. REPORT DATE October 1980 |
| 16. DISTRIBUTION STATEMENT Approved for release; distribution unlimited. | | 13. NUMBER OF PAGES Approximately 60 |
| 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) | | 15. SECURITY CLASS. (of this report) UNCLASSIFIED |
| 18. SUPPLEMENTARY NOTES | | 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |
| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property. | | |

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

LIPPS LAKE DAM
CAPE GIRARDEAU COUNTY, MISSOURI
MISSOURI INVENTORY NO. MO 30214

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR
GOVERNOR OF MISSOURI

OCTOBER, 1980

| | |
|--------------------|--|
| Distribution For | |
| GRA&I | <input checked="checked" type="checkbox"/> |
| NO TAB | <input type="checkbox"/> |
| Announced | <input type="checkbox"/> |
| Justification | |
| By | |
| Distribution/ | |
| Availability Codes | |
| Avail and/or | |
| Special | |

A

This document has been approved
for public release and sale; its
distribution is unlimited.



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

SUBJECT: Lipps Lake Dam - MO 30214

This report presents the results of field inspection and evaluation of the Lipps Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: **SIGNED**
Chief, Engineering Division

28 APR 1981

Date

APPROVED BY: **SIGNED**
Colonel, CE, District Engineer

28 APR 1981

Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

| <u>PARAGRAPH NO.</u> | <u>TITLE</u> | <u>PAGE NO.</u> |
|----------------------|---|-----------------|
| | Assessment Summary | |
| | Overview Photograph | |
| | SECTION 1 - PROJECT INFORMATION | |
| 1.1 | General | 1 |
| 1.2 | Description of Project | 1 |
| 1.3 | Pertinent Data | 2 |
| | SECTION 2 - ENGINEERING DATA | |
| 2.1 | Design | 5 |
| 2.2 | Construction | 5 |
| 2.3 | Operation | 5 |
| 2.4 | Evaluation | 5 |
| | SECTION 3 - VISUAL INSPECTION | |
| 3.1 | Findings | 6 |
| 3.2 | Evaluation | 8 |
| | SECTION 4 - OPERATIONAL PROCEDURES | |
| 4.1 | Procedures | 9 |
| 4.2 | Maintenance of Dam | 9 |
| 4.3 | Maintenance of Operating Facilities | 9 |
| 4.4 | Description of Any Warning System in Effect | 9 |
| 4.5 | Evaluation | 9 |
| | SECTION 5 - HYDRAULIC/HYDROLOGIC | |
| 5.1 | Evaluation of Features | 10 |
| | SECTION 6 - STRUCTURAL STABILITY | |
| 6.1 | Evaluation of Structural Stability | 11 |
| | SECTION 7 - ASSESSMENT/REMEDIAL MEASURES | |
| 7.1 | Dam Assessment | 12 |
| 7.2 | Remedial Measures | 12 |

APPENDIX A - MAPS

| | |
|-----------|---------------------|
| Plate A-1 | Vicinity Topography |
| Plate A-2 | Location Map |
| Plate A-3 | Seismic Zone Map |

APPENDIX B - PHOTOGRAPHS

| | | |
|------------|--------------|--|
| Plate B-1 | | Photo Index |
| Plate B-2 | Photo No. 2 | Upstream Slope Taken from Left End |
| | Photo No. 3 | Crest as Seen from Left End |
| Plate B-3 | Photo No. 4 | Downstream Slope and Top of Berm as Seen from Left End |
| | Photo No. 5 | Downstream Slope and Top of Berm as Seen from Left End |
| Plate B-4 | Photo No. 6 | Looking Upstream from Station 5 + 00 |
| | Photo No. 7 | Looking Upstream from Station 5 + 00 |
| Plate B-5 | Photo No. 8 | Looking Downstream from Station 5 + 00 |
| | | Showing Damage Area Just Below Dam |
| | Photo No. 9 | Looking Downstream from Station 5 + 00 |
| | | Showing Damage Area Just Below Dam |
| Plate B-6 | Photo No. 10 | Crest of Dam from Right End |
| | Photo No. 11 | Upstream Slope as Seen from Right Abutment |
| Plate B-7 | Photo No. 12 | View Showing Exposure in Right Abutment |
| | Photo No. 13 | Overview from High Upstream on the Center Point |
| Plate B-8 | Photo No. 14 | Spring Area on Top of the Dam, Past Station 10 + 00 |
| | Photo No. 15 | Downstream Slope from Right Abutment Trough |
| Plate B-9 | Photo No. 16 | View Showing Foxtail in the Left Abutment Trough and Willows on Downstream Slope |
| | | Looking Up Slope |
| | Photo No. 17 | Spring Area on Top of Dam Looking Back (West) Into the Hill |
| Plate B-10 | Photo No. 18 | View Showing Trailer Homes in Hazard Area West of Road |

APPENDIX C - PROJECT PLATES

| | |
|-----------|---|
| Plate C-1 | Phase I - Plan of Dam and Centerline Profile of Dam |
| Plate C-2 | Phase I - Maximum Cross Section of Dam - Station 5+50 |

APPENDIX D - HYDRAULIC AND HYDROLOGIC COMPUTATIONS

| | |
|------------------------|---|
| Plates D-1 | Hydrologic Computations |
| Plate D-2 | Elevation Area Curve |
| Plate D-3 through D-21 | Computer Input and Output for Ratios of PMF |

APPENDIX E - PRELIMINARY SLOPE STABILITY ANALYSES

Plate E-1
Plate E-2

Computation Parameters and Results
Computer Printout

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

| | |
|--------------------|----------------------------------|
| Name of Dam | Lipps Lake Dam |
| State Located | Missouri |
| County Located | Cape Girardeau County |
| Stream | Tributary to Little Indian Creek |
| Date of Inspection | October 30, 1980 |

Lipps Lake Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderregger, Inc. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Lipps Lake Dam has a height of seventy-five (75) feet and a storage capacity at the minimum top elevation of the dam of six hundred forty (640) acre-feet. In accordance with the guidelines, an intermediate size dam has a height greater than or equal to forty (40) feet but less than one hundred (100) feet and a storage capacity greater than or equal to one thousand (1,000) acre-feet but less than fifty thousand (50,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Lipps Lake Dam is classified as an intermediate size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately three (3) miles downstream of the dam to the Mississippi River flood plain. Within the damage zone are four dwellings, a barn, Highway V, two trailer houses and Highway 117.


Our inspection and evaluation indicate that Lipps Lake Dam meets the criteria set forth in the recommended guidelines for an intermediate size dam having a high hazard potential. There are no spillways for this dam. The Probable Maximum Flood, which is the appropriate spillway design flood, will be contained by this dam with no outflow and with no danger of overtopping. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

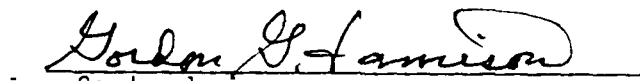
Lipps Lake Dam is in good condition. The deficiencies noted are the lack of good vegetative cover on the embankment slopes, tree and brush growth on the embankment slopes and the lack of seepage and stability analyses as required by the guidelines for all dams having a high hazard potential.


No design data were available for this dam. Based on the observations and measurements made during the inspection and upon the hydraulic/hydrologic analysis performed for this dam, no modification of the dam is considered necessary.

The following recommendations are made in regard to operation and maintenance of the dam:

- (1) Seepage and stability analysis comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.
- (2) A good vegetative cover of adapted grasses and legumes should be established on the embankment slopes, particularly the upstream slope.
- (3) To facilitate maintenance of the recommended vegetative cover tree growth should be removed from the upstream slope and measures should be taken to prevent their recurrence.
- (4) Tree growth on the downstream slope should be removed below about elevation 420 and measures should be taken to prevent recurrence. This should protect the area below maximum potential phreatic surface emergence.
- (5) Tree and brush growth on the downstream slope above elevation 420 should be selectively removed and controlled so that grass and legume cover can be maintained and future inspections can be easily conducted.
- (6) A program of periodic inspection and maintenance should be initiated with inspection reports being made a part of the file on this dam. This program should be carried out under the guidance of an engineer experienced in the design and construction of dams.


Rey S. Decker
E-3703


Gordon Jamison


Garold Ulmer
E-19246

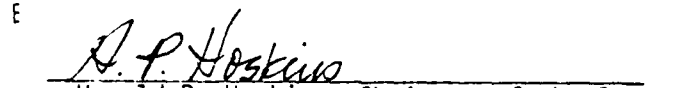

Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LIPPS LAKE DAM - MO 30214
CAPE GIRARDEAU COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Lipps Lake Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances.
 - (1) Embankment. The embankment is a compacted earthfill approximately 800 feet in length and 75 feet in height. The maximum storage capacity at the minimum top elevation of the dam is 640 \pm acre-feet.
 - (2) Principal Spillway. There is no principal spillway.
 - (3) Emergency Spillway. There is no emergency spillway.
 - (4) Low-Level Outlet. There is no low-level outlet.
 - (5) Pertinent physical data are given in paragraph 1.3.
- b. Location. The dam is located in the northcentral portion of Cape Girardeau County, Missouri, approximately 9 miles north of the

city of Cape Girardeau, as shown on Plate A-2. The dam and reservoir are shown on Plate A-1 in the SE 1/4 Sec. 7, T32N, R14E.

- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Lipps Lake Dam has a height of 75 feet \pm and a storage capacity of 640 acre-feet. This dam is classified as an intermediate size dam. An intermediate size dam has a height greater than or equal to 40 feet but less than 100 feet and a storage capacity greater than or equal to 1,000 acre-feet but less than 50,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.
- d. Hazard Classification. Guidelines for determining hazard classification of dams and impoundments are presented in the guidelines as referenced in paragraph 1.1c above.

Aerial photographs of the downstream damage zone of this dam were taken in October, 1980. These photographs were used as reference in the field observations of the damage zone which were made during the inspection. Based on the field observations and on the referenced guidelines, this dam is in the High Hazard Potential Classification. The estimated damage zone extends approximately three miles downstream of the dam to the Mississippi River flood plain. Within the damage zone are four dwellings, a barn, Highway V, two trailer houses and Highway 117. Photos 1, 8, 9 and 18 show the damage zone.

- e. Ownership. This dam is owned by Mr. Jerry Lipps, 130 S. Frederick, Cape Girardeau, Missouri 63701.
- f. Purpose of Dam. The dam was built for recreational purposes.
- g. Design and Construction History. No design or construction data were available for this dam. Mr. Lipps reported that he built this dam himself in 1973.
- h. Normal Operating Procedure. There are no operating facilities for this dam. The pool level is controlled by rainfall, infiltration, and evaporation.

1.3 PERTINENT DATA

- a. Drainage Area. 63.1 acres (0.099 square miles).
- b. Discharge at Damsite.
 - (1) There are no outlet facilities for this dam.
 - (2) Estimated maximum flood at damsite -- Unknown. (Based on high water marks the reservoir has risen to an elevation of 439.8).

c. Elevations (feet above M.S.L.).

- (1) Observed pool - 436.2
- (2) Normal pool - unknown
- (3) Spillway crests - there are no spillways
- (4) Maximum experienced pool - 439.8 (observed high water line)
- (5) Top of dam (minimum) - 466.8
- (6) Steambed - 399[±]
- (7) Maximum tailwater - none

d. Reservoir. Length (feet) of pool.

- (1) At observed pool - 1100[±]
- (2) At top of dam (minimum) - 2500[±]

e. Storage (acre-feet).

- (1) Observed pool - 142[±]
- (2) Normal pool - unknown
- (3) Spillway crests - there are no spillways
- (4) Maximum experienced pool - 180[±]
- (5) Top of dam (minimum) - 640[±]

f. Reservoir Surface (acres).

- (1) Observed pool - 9.5[±]
- (2) Normal pool - unknown
- (3) Spillway crests - there are no spillways
- (4) Maximum experienced pool - 11[±]
- (5) Top of dam (minimum) - 25.5[±]

g. Dam.

- (1) Type - earthfill
- (2) Length - 800 feet

- (3) Height - 75 feet (maximum)
- (4) Top width - variable (16 ft. to 33 ft.)
- (5) Side slopes
 - (a) Downstream - 1V on 1.6H - crest to berm
1V on 20.2H - berm
1V on 2.1/2.9/3.3/4.1/5.4H - berm to toe
 - (b) Upstream - 1V on 2.5H
- (6) Zoning - reported as homogeneous fill
- (7) Impervious core - homogeneous fill
- (8) Cutoff - unknown (reported to rock)
- (9) Grout curtain - none
- (10) Wave protection - none
- (11) Drains - none
- h. Diversion Channel and Regulating Tunnel. None
- i. Spillways. There are no spillways for this dam.
- j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. Mr. Lipps reported he built this dam in 1973 using DW-21 scrapers and dozers.

2.3 OPERATION

There are no operating facilities for this dam.

2.4 EVALUATION

- a. Availability. No data were available.
- b. Adequacy. The field surveys and visual observations presented in this report are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of the Lipps Lake Dam was made on October 30, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were:

Rey S. Decker - Geotechnical
Garold G. Ulmer - Hydraulics and Hydrology
Gordon Jamison - Hydraulics and Hydrology
Roy Elliott - Geology

The owner, Mr. Jerry Lipps, was interviewed prior to the inspection but was not present during the inspection.

- b. Dam.

- (1) Geology and Soils (abutment and embankment). The embankment is situated in a bedrock controlled upland drainage. The physiographic province is typical of the eastern margin of the Ozark uplift, gently dipping Paleozoic bedrock incised by modern drainage and mantled by moderate to thick loess. The thinly to massive bedded limestones are interbedded with chert and shale. The bedrock formations are exposed in the upstream right abutment. They are Devonian in age and locally fossiliferous (ammonites, brachiopods and crinoids). The underlying bedrock dips gently to the east at less than 5°. Structural features of local importance are the Jackson Fault 7 miles to the south; Brooks Dome 6 miles to the south-southeast and Bodenschatz-Lick Fault of the Genevieve Fault System 9 miles to the north-northwest. The embankment is located in Seismic Zone 3 which is indicative of major seismic probability. Earthquakes with Modified Mercalli intensities greater than or equal to V occurred in 1819 and twice in 1977 within 25 radial miles of the site. Within this radius earthquakes with minor intensities (I to IV) were recorded in 1928, 1938, 1940, 1944 and 1977.

Loess deposits ranging in thickness from 1 to 15 feet mantle the hilltops and valley slopes. The soils in the drainage basin consist of the Menfro-Winfield association which are developed on loess overlying cherty limestone. Materials in the embankment and abutments consist of CL-ML loess and CL-CH residuum with considerable cherty gravel which has been borrowed from the abutment areas. Materials were field classified from samples taken by hand auger.

Groundwater movement at and adjacent to the embankment is controlled by bedding and fractures in the limestone and the

poorly sorted clayey gravel alluvium. Solution cavitation was not observed in the limestones. "Perched" drainage of the loess mantle was observed on the massive cherty limestone at the crest of the right abutment. This seep should not affect the stability of the structure due to its location and small recharge area.

- (2) Upstream Slope. The upstream slope has a very sparse vegetative cover of weeds and annuals. There are a number of small Sycamore trees growing on the upstream slope. There is no riprap on the upstream face, and there is a definite wash line about 3.5± feet above the present water surface. There were no indications of slumps, cracks, slides or rodent activity on the slope. Some erosional rills, up to 8 to 12 inches in depth, were observed on the slope. Photos 2, 11, & 13 show the upstream slope.
- (3) Crest. Station 3+00 on the left side is approximately 9 feet higher than Station 10+00 on the right end. The profile slopes uniformly between these stations. The width of the crest varies from 16 feet minimum to 33 feet maximum. The crest is sparsely vegetated with weeds and annuals and serves as a road for vehicular travel. The material on the crest is CL-CH with cherty gravel. No cracks, deformations, evidence of unequal settlement, or rodent holes were observed. There is a seep area on the right abutment (Station 10+00) at or slightly above the top of dam elevation. It apparently emerges from the abutment and has no connection with the reservoir or stability of the dam. Photos 14 and 17 show the spring on top of the dam. Photos 3 and 10 show the crest.
- (4) Downstream Slope. The downstream slope has a sparse vegetative cover of grass and weeds. There is a wide berm on the downstream slope located approximately 23 feet below the crest elevation at the maximum section. The berm width varies considerably, ranging from approximately 20 to 60 feet. There was no evidence of cracks, slides, slumps, excessive erosion or rodent holes on the downstream slope. Seepage was not observed along the toe of the slope. A few small Sycamore trees are growing on the slope and berm. A few small Willow trees are growing on the slope downstream from about Station 5+50 to 7+50. These Willows are located at about elevation 415 which should be about the emerging elevation of the phreatic line with the pool elevation at 436 to 440. No other signs of seepage were observed on the slope. Photos 4, 5, 15, and 16 show the downstream slope.
- (5) Miscellaneous. This dam appears to be at least a third higher than would normally be constructed for a small watershed of this size. The abnormally large cross-section of the dam resulting from the overbuilding should preclude any impairment

to the safety of the embankment from tree growth on the slopes or from natural emergence of the phreatic line on the downstream slope.

- c. Appurtenant Structures. There are no spillways or draw-down facilities for this dam.
- d. Reservoir Area. There is no significant erosion around the shoreline. All trees have been removed around the periphery some 20 to 30 feet above the waterline and there is evidence that some of the shoreline material was used as borrow for the dam. There was no evidence of siltation in the reservoir. The remainder of the cleared area probably reflects the owner's optimistic plans for a much larger reservoir than the watershed can support. Photos 6 and 7 show these conditions.
- e. Downstream Channel. There is no evidence of channel use over the past few years. It appears the original channel has been filled in with tailings and undesirable construction material. Photos 8 and 9 show the area downstream from the dam.

3.2 EVALUATION

This dam appears to be safe from the standpoint of shear failures and/or seepage pressures. The fact that the upper one-third of the downstream slope is steeper than normal should not detract from the safety of the dam since it is doubtful that the reservoir level will ever approach this elevation. The relatively low reservoir level, the nature of the materials in the dam, and the abnormally large base width and cross-section of the dam should preclude any serious impairment to the safety of the dam by tree growth, by emergence of the phreatic line, and by seismic activity.

There are no spillways or draw-down facilities for this dam. It is remotely possible that concurrent storms of high intensity and/or duration could fill the reservoir to within a few feet of top of the dam. Under such circumstances it would probably be advisable to then construct a spillway or other measures to lower and/or control the level of the reservoir.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no outlet works for this dam. The pool level is controlled by rainfall, infiltration, and evaporation.

4.2 MAINTENANCE OF DAM

There does not appear to be any regular maintenance program for this dam. Some small gully and rill erosion is evident on the upstream slope. A few small Sycamore and Willow trees are growing on both slopes of the dam.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

Although it appears that the abnormally large cross-section of this dam would preclude any serious damage to the structure from tree growth, it would be advisable to remove the small trees from the embankment and measures should be taken to prevent their recurrence. Removal of the trees at this stage will facilitate future maintenance of the structure. It would also be advisable to establish a good vegetative cover of adapted grasses and legumes (crown vetch) on the slopes of the embankment. The lack of outlet works for this structure could result in problems of reservoir stagnation and eutrophication unless some special measures are initiated.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. There were no design data available for this dam.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Cape Girardeau NE, MO. 7-1/2 minute topographic quadrangle map.
- c. Visual Observations.
 - (1) The size of this dam, in comparison to its contributing drainage area, is so large that the lack of outflow facilities is of little consequence.
- d. Overtopping Potential. There is no overtopping potential. Without outflow facilities the probable maximum flood pool elevation is approximately 15 feet below the minimum top of dam.

The results of the routings through the dam are tabulated in regards to the following conditions:

| <u>Frequency</u> | <u>Inflow Discharge c.f.s.</u> | <u>Outflow Discharge c.f.s.</u> | <u>Maximum Pool Elevation</u> | <u>*Maximum Depth Over Dam Feet</u> | <u>Duration Over Top Hours</u> |
|------------------|--|---|---------------------------------------|---|--|
| 1% | 195 | 0 | 441.2 | - | - |
| 1/2 PMF | 615 | 0 | 446.7 | - | - |
| PMF | 1230 | 0 | 452.3 | - | - |

* Minimum top of dam elevation - 466.8 feet.

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard potential and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam.

The estimated damage zone is described in paragraph 1.2 d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. This dam appears to be structurally stable against shear failures and seepage pressures. No evidence of stress such as cracks, slumps, slides or deformations were observed during the inspection. There, also, was no evidence of seepage through the embankment or along the toe.

Appendix E of this report contains a preliminary static slope stability analysis which was performed for this dam.

- b. Design and Construction Data. No design or construction data were available for this dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. Computer assisted static slope stability analyses were performed for this report. Results of these analyses are included in Appendix E.
- c. Operating Records. There are no operating facilities for this dam.
- d. Post-Construction Changes. The inspection team is not aware of any post-construction changes.
- e. Seismic Stability. This dam is located in Seismic Zone 3 as shown on Plate A-3. An earthquake of the magnitude predicted in this area could be expected to cause some damage to this dam. However, preliminary static stability analyses using horizontal acceleration of 0.15g produced safety factors that are generally acceptable. (See Appendix E).

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- a. Safety. This dam appears to be structurally stable with only a slight possibility of failure from shear, seepage and/or seismic stresses. Approximate analyses, presented in this report, indicate that the dam will impound the probable maximum flood with about 15 feet of free board.

There are no spillways or draw-down facilities for this dam. It is remotely possible that concurrent storms of high intensity and/or duration could fill the reservoir to within a few feet of top of the dam. Under such circumstances it would probably be advisable to then construct a spillway or other measures to lower and/or control the level of the reservoir. The lack of outlet works for this structure could result in problems of reservoir stagnation and eutrophication unless some special measures are initiated.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. However, preliminary slope stability analyses, presented in Appendix E of this report, indicate that this dam would be structurally stable under full pool (PMF) and steady seepage with earthquake forces expected for this area. Considering the abnormally large cross-section of this dam, it is doubtful that surface erosion on the upstream slope and tree growth on the embankment would ever result in serious potential of failure. However, the establishment of good grass and/or legume cover on the slopes and control of the tree growth will minimize and ease future maintenance requirements for this structure.

- b. Adequacy of Information. No engineering data were available for this dam. The information collected during the inspection, the analyses presented in Section 5 and the performance history of the dam are considered adequate to support the conclusions presented in this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Urgency. There does not appear to be any urgency to perform the remedial measures recommended in paragraph 7.2.
- d. Necessity for Further Investigation. There is no apparent need for Phase II investigations.
- e. Seismic Stability. This dam is located in Seismic Zone 3 as shown on Plate A-3. An earthquake of this magnitude could be expected to cause some damage to this dam. It is recommended that the

prescribed seismic loading for Seismic Zone 3 be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

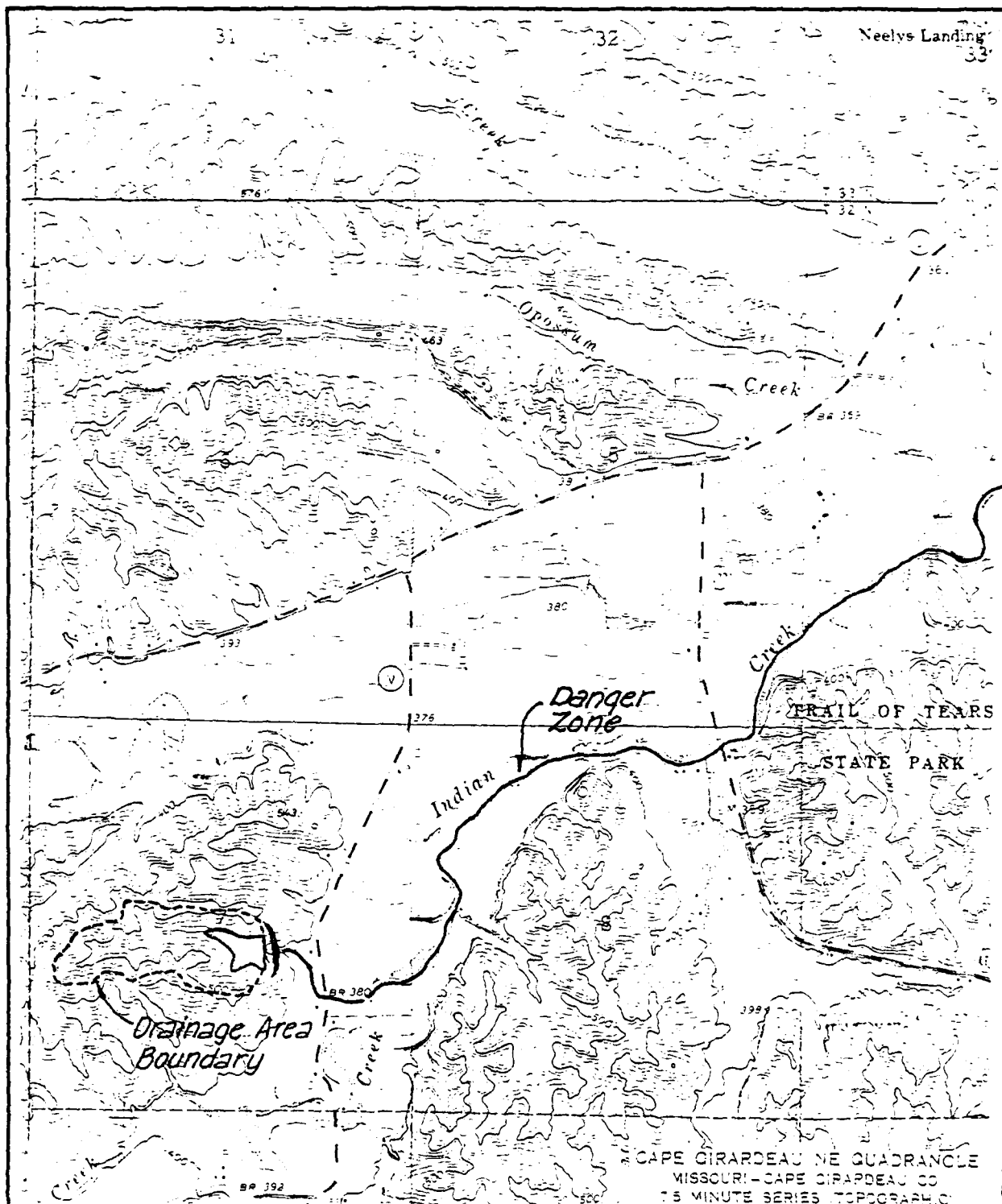
a. Alternatives.

- (1) Since the dam will impound the Probable Maximum Flood with no danger of overtopping, no alternatives are required.

b. Operation and Maintenance Procedures.

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.
- (2) A good vegetative cover of adapted grasses and legumes should be established on the embankment slopes, particularly the upstream slope.
- (3) To facilitate maintenance of the recommended vegetative cover, tree growth should be removed from the upstream slope and measures should be taken to prevent their recurrence.
- (4) Tree growth on the downstream slope should be removed below about elevation 420 and measures should be taken to prevent recurrence. This should protect the area below maximum potential phreatic surface emergence.
- (5) Tree and brush growth on the downstream slope above elevation 420 should be selectively removed and controlled so that grass and legume cover can be maintained and future inspections can be easily conducted.
- (6) A program of periodic inspection and maintenance should be initiated with inspection reports being made a part of the file on this dam. This program should be carried out under the guidance of an engineer experienced in the design and construction of dams.

APPENDIX A
MAPS



Scale in feet
2000 1000 0 2000 4000

Contour Interval - 20'



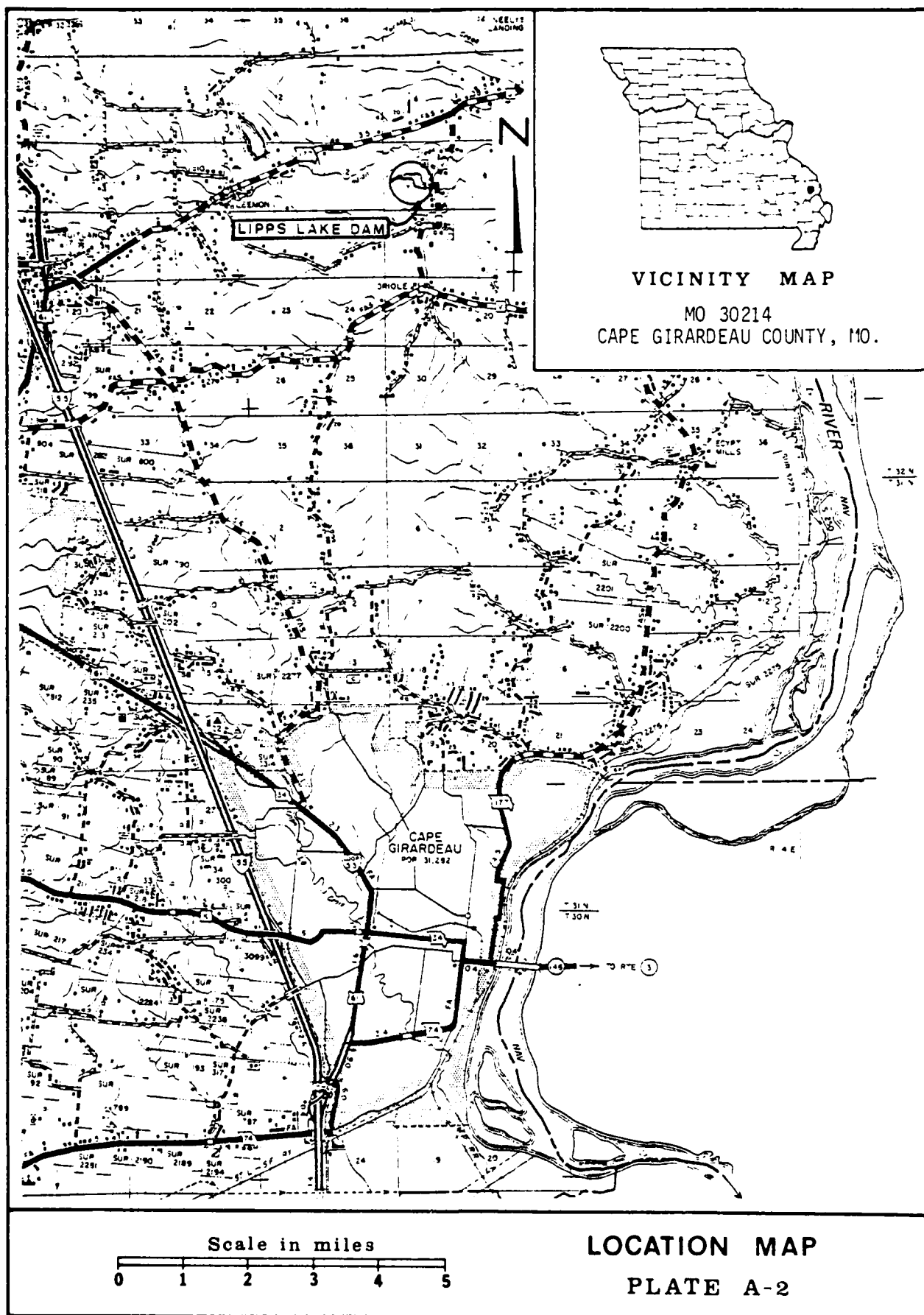
VICINITY TOPOGRAPHY

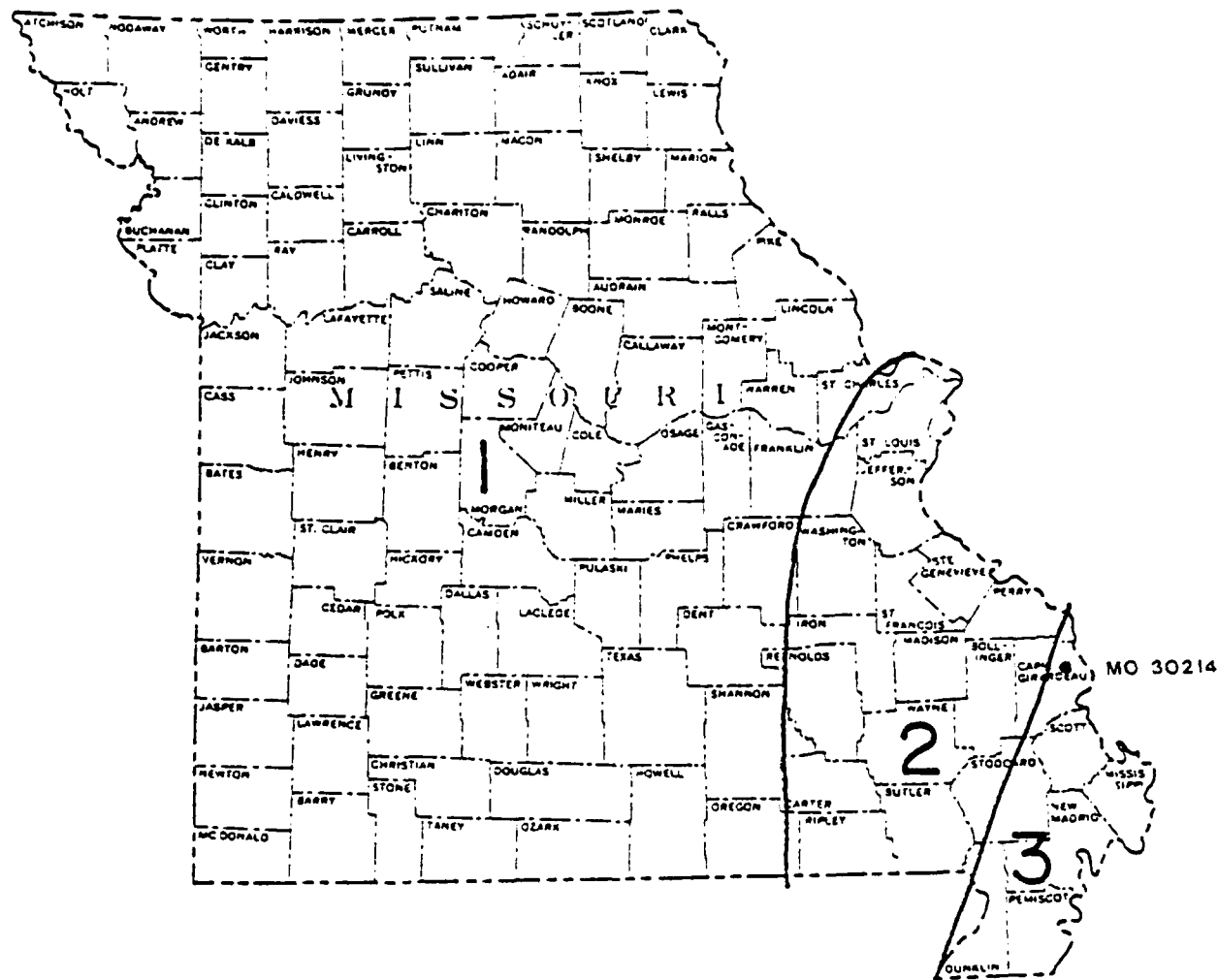
LIPPS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 30214

PLATE A-1





MISSOURI
SEISMIC ZONE MAP

APPENDIX B
PHOTOGRAPHS



LIPPS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 30214

PHOTO INDEX

PLATE B-1



PHOTO NO. 2 - UPSTREAM SLOPE TAKEN FROM LEFT END



PHOTO NO. 3 - CREST AS SEEN FROM LEFT END



PHOTO NO. 4 - DOWNSTREAM SLOPE AND TOP OF BERM AS SEEN FROM LEFT END



PHOTO NO. 5 - DOWNSTREAM SLOPE AND TOP OF BERM AS SEEN FROM LEFT END



PHOTO NO. 6 - LOOKING UPSTREAM FROM STATION 5 + 00



PHOTO NO. 7 - LOOKING UPSTREAM FROM STATION 5 + 00



PHOTO NO. 8 - LOOKING DOWNSTREAM FROM STATION 5 + 00 SHOWING
DAMAGE AREA JUST BELOW DAM



PHOTO NO. 9 - LOOKING DOWNSTREAM FROM STATION 5 + 00 SHOWING
DAMAGE AREA JUST BELOW DAM



PHOTO NO. 10 - CREST OF DAM FROM RIGHT END



PHOTO NO. 11 - UPSTREAM SLOPE AS SEEN FROM RIGHT ABUTMENT



PHOTO NO. 12 - VIEW SHOWING
EXPOSURE IN RIGHT ABUTMENT



PHOTO NO. 13 - OVERVIEW FROM HIGH UPSTREAM ON THE CENTER POINT



PHOTO NO. 14 - SPRING AREA ON TOP OF THE DAM, PAST STATION
10 + 00



PHOTO NO. 15 - DOWNSTREAM SLOPE FROM RIGHT ABUTMENT TROUGH



PHOTO NO. 16 - VIEW SHOWING FOXTAIL IN THE LEFT ABUTMENT
TROUGH AND WILLOWS ON DOWNSTREAM SLOPE LOOKING UP SLOPE



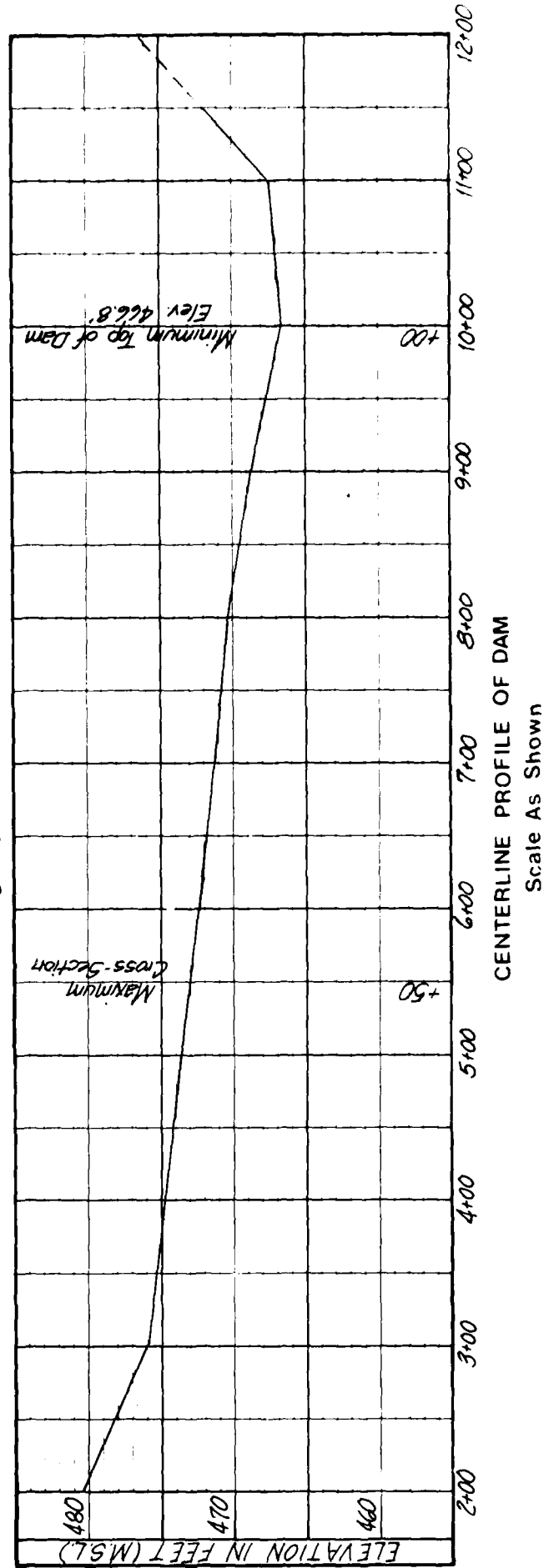
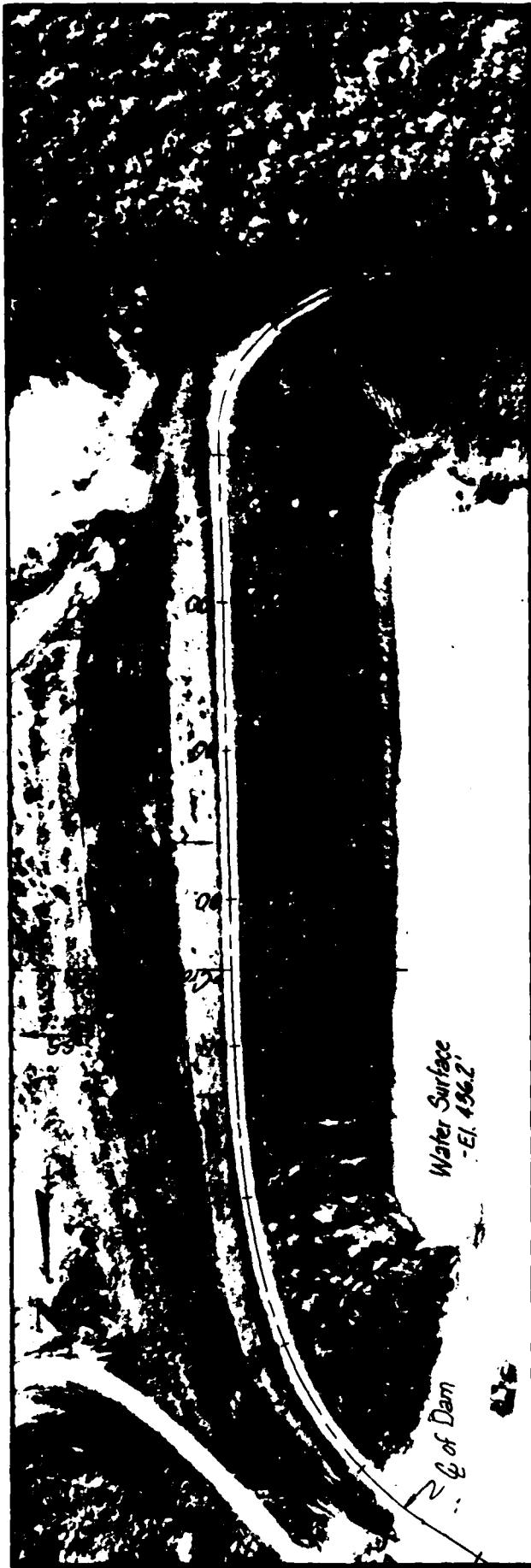
PHOTO NO. 17 - SPRING AREA
ON TOP OF DAM LOOKING BACK
(WEST) INTO THE HILL

FORM 12 8-1-12



PHOTO NO. 18 - VIEW SHOWING TRAILER HOMES IN HAZARD AREA
WEST OF ROAD

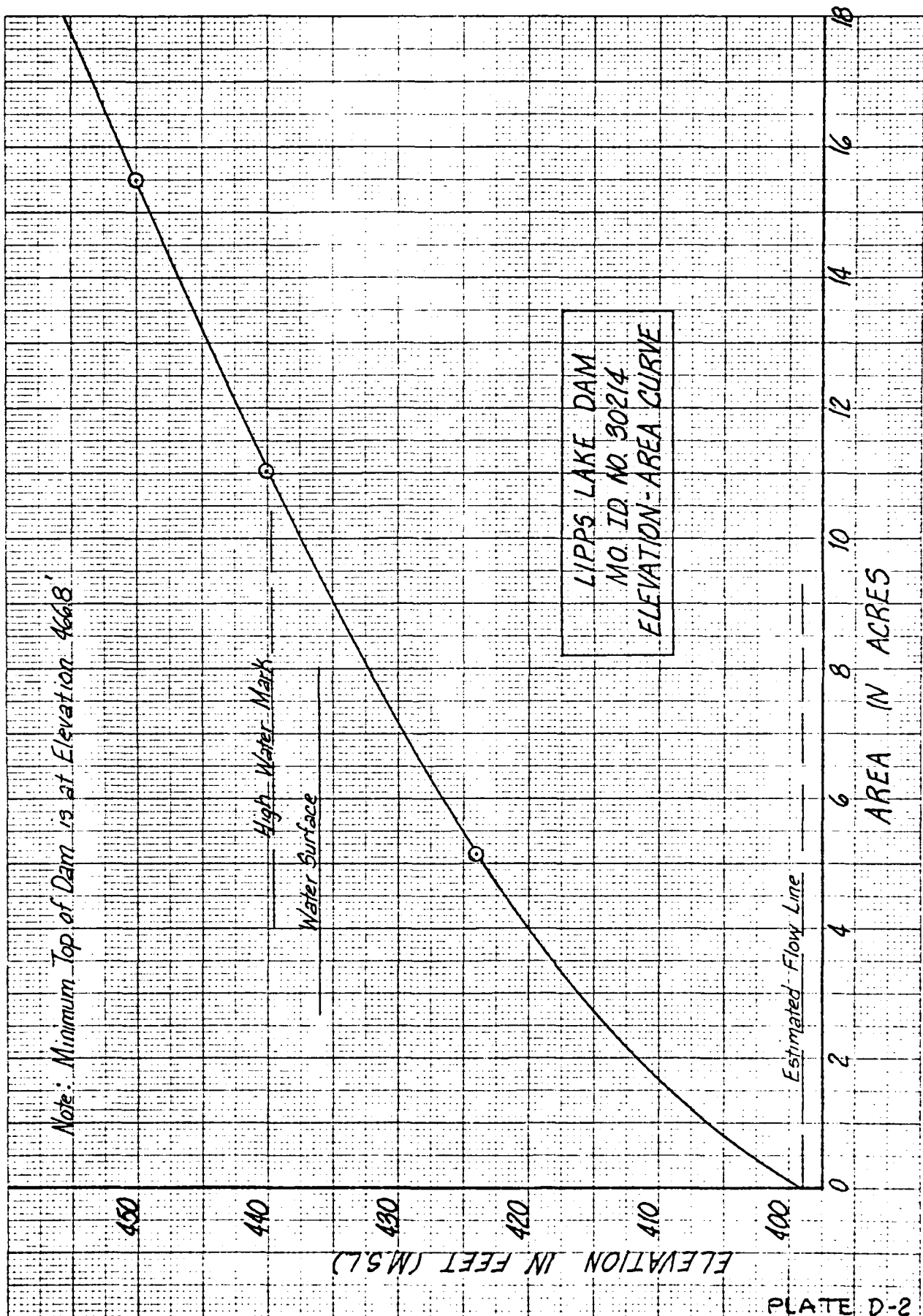
APPENDIX C
PROJECT PLATES



APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (see this Appendix).
 - a. Twenty-four hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Cape Girardeau, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.
 - b. Drainage area = 0.099 square miles (63.1 acres).
 - c. Time of concentration of runoff = 12 minutes (computed from the Kirpich formula and formula from California Culverts Practice, California Highways and Public Works).
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the maximum wash line elevation as determined in the field surveys.
 - e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 4.02 inches. The total losses for the PMF storm were 2.67 inches. These data are based on SCS runoff curve No. 64 and No. 81 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed primarily of SCS soil group B (Menfro-Clarksville complex). Land use is 90% woods and 10% impervious.
 - f. Average soil loss rates = 0.10 inch per hour approximately (for PMF storm, AMC III).
2. The only outflow possibility for this dam would be that over the top of the dam.
3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the dam embankment crest. The input and plotted hydrographs are attached in this Appendix.



 FLOOD CONTROL DISTRICT
 DAM SAFETY DIVISION
 LAST MODIFICATION 26 FEB 1978

RUN DATE 00/12/11.
 TIME 17.47.93.

LIPPS LAKE DAM/MO ID NO 50214
 SAFETY-ANALYSIS OF DAM OVERTOPPING USING ASSIGNED FLOOD FREQUENCIES
 H & H ANALYSIS BY ROUTING PMF RATIOS THRU THE RESERVOIR

NO 288 NHN 0 IDAY 5 JOPER 5 JH 0 IRIN 0 METRC 0 IPLT 0 IPHT 3 INSTAN 0
 JOB SPECIFICATION
 NHN 0 LKOP 0 TRACE 0

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NHTIO= 7 LKTH= 1
 HTIO= .10 .20 .40 .50 .60 .80 1.00

***** SUB-AREA RUNOFF COMPUTATION *****

CALCULATION OF INFLOW-HYDRO TO LIPPS LAKE

ISTAO 000001 ICOMP 0 IECUN 0 ITAPE 0 JPLT 0 INAME I STAGE 0 I AUTO 0

INHYG 1 LUNG 2 TAREA 10 SNAP 1000 HYDROGRAPH DATA
 RATIO 0.000 ISNOW 0 ISAME 1 LOCAL 0

PRECIP DATA
 SPFE 0.00 PMS 27.00 H6 102.00 H12 121.00 R24 150.00 R46 0.00 R96 0.00

LKOPJ 0 STKRK 0.00 DLYKH 0.00 NIOL 1.00 ERAIN 0.00 LOSS DATA
 RTIOK 1.00 STRTL -1.00 CNSTL -81.00 ALSMX 0.00 RTIMP 0.00

CURVE NO = -81.00 WEIKNSS = -1.00 EFFECT CN = 81.00

UNIT HYDROGRAPH DATA
 TC= 0.00 LAG= .17

RECESSION DATA
 STRTG= 0.00 GRCSH= -.01 RTIOK= 1.00

UNIT HYDROGRAPH 12 LND OF PERIOD ORIGINATES, TC= 36, 0.00 HOURS, LAG= 10, .17 VOL= 1.00 3.

| MO. UA | HR. MH | PERIOD | RAIN | EXCS | LOSS | END-OF-PERIOD FLOW | HR. MH | PERIOD | MAIN | EXCS | LOSS | COMP U |
|--------|--------|--------|------|------|------|--------------------|--------|--------|------|------|------|--------|
| 1.01 | 0.05 | 1 | 0.01 | 0.00 | 0.01 | 1.01 | 12.05 | 145 | 23 | 21 | 02 | 60. |
| 1.01 | 1.15 | 2 | 0.01 | 0.00 | 0.01 | 1.01 | 12.10 | 146 | 23 | 21 | 02 | 60. |
| 1.01 | 2.25 | 3 | 0.01 | 0.00 | 0.01 | 1.01 | 12.15 | 147 | 23 | 21 | 02 | 60. |
| 1.01 | 3.35 | 4 | 0.01 | 0.00 | 0.01 | 1.01 | 12.20 | 148 | 23 | 21 | 02 | 60. |
| 1.01 | 4.45 | 5 | 0.01 | 0.00 | 0.01 | 1.01 | 12.25 | 149 | 23 | 21 | 02 | 60. |
| 1.01 | 5.55 | 6 | 0.01 | 0.00 | 0.01 | 1.01 | 12.30 | 150 | 23 | 21 | 02 | 60. |
| 1.01 | 6.65 | 7 | 0.01 | 0.00 | 0.01 | 1.01 | 12.35 | 151 | 23 | 21 | 02 | 60. |
| 1.01 | 7.75 | 8 | 0.01 | 0.00 | 0.01 | 1.01 | 12.40 | 152 | 23 | 21 | 02 | 60. |
| 1.01 | 8.85 | 9 | 0.01 | 0.00 | 0.01 | 1.01 | 12.45 | 153 | 23 | 21 | 02 | 60. |
| 1.01 | 9.95 | 10 | 0.01 | 0.00 | 0.01 | 1.01 | 12.50 | 154 | 23 | 21 | 02 | 60. |
| 1.01 | 11.05 | 11 | 0.01 | 0.00 | 0.01 | 1.01 | 12.55 | 155 | 23 | 21 | 02 | 60. |
| 1.01 | 12.15 | 12 | 0.01 | 0.00 | 0.01 | 1.01 | 13.00 | 156 | 23 | 21 | 02 | 60. |
| 1.01 | 13.25 | 13 | 0.01 | 0.00 | 0.01 | 1.01 | 13.05 | 157 | 23 | 21 | 02 | 60. |
| 1.01 | 14.35 | 14 | 0.01 | 0.00 | 0.01 | 1.01 | 13.10 | 158 | 23 | 21 | 02 | 60. |
| 1.01 | 15.45 | 15 | 0.01 | 0.00 | 0.01 | 1.01 | 13.15 | 159 | 23 | 21 | 02 | 60. |
| 1.01 | 16.55 | 16 | 0.01 | 0.00 | 0.01 | 1.01 | 13.20 | 160 | 23 | 21 | 02 | 60. |
| 1.01 | 17.65 | 17 | 0.01 | 0.00 | 0.01 | 1.01 | 13.25 | 161 | 23 | 21 | 02 | 60. |
| 1.01 | 18.75 | 18 | 0.01 | 0.00 | 0.01 | 1.01 | 13.30 | 162 | 23 | 21 | 02 | 60. |
| 1.01 | 19.85 | 19 | 0.01 | 0.00 | 0.01 | 1.01 | 13.35 | 163 | 23 | 21 | 02 | 60. |
| 1.01 | 20.95 | 20 | 0.01 | 0.00 | 0.01 | 1.01 | 13.40 | 164 | 23 | 21 | 02 | 60. |
| 1.01 | 22.05 | 21 | 0.01 | 0.00 | 0.01 | 1.01 | 13.45 | 165 | 23 | 21 | 02 | 60. |

CFS 614. 142. 43. 43. 12403.
 CFS 17. 1. 1. 1. 351.
 INCHES 13.38 16.19 16.19 16.19
 AC-FT 339.79 411.20 411.20 411.20
 THOUS CU M 71. 85. 105. 105.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

PLAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 737. 171. 52. 14886.
 CFS 21. 1. 1. 422.
 INCHES 16.05 19.43 19.43 19.43
 AC-FT 407.75 493.43 493.43 493.43
 THOUS CU M 85. 103. 103. 103.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

PLAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 982. 228. 89. 19846.
 CFS 28. 8. 8. 256.
 INCHES 21.40 25.50 25.50 25.50
 AC-FT 543.67 657.91 657.91 657.91
 THOUS CU M 113. 137. 137. 137.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

PLAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 1228. 288. 89. 24703.
 CFS 33. 8. 8. 320.
 INCHES 26.76 32.38 32.38 32.38
 AC-FT 679.59 822.39 822.39 822.39
 THOUS CU M 141. 171. 171. 171.

HYDROGRAPH ROUTING

ROUTED FLOWS THRU LIPPS LAKE DAM

ISTAQ ICUMP IECUN ITAPE JPLT JPRI INAME ISTAGL IAU0
 000002 1 0 0 2 0 1 0
 QLOSS CLOSS AVG ROUTING DATA IOPT IPMP LSTR
 0.0 0.000 0.00 1 1 0 0
 NSTPS ANSTOL LAG AMSKK X TSM STORA ISPHAT
 1 0 0 0.000 0.000 0.000 -440.

STAGE 466.80
 FLOW 0.00

SURFACE AREA= 0. 2. 4. 5. 7. 11. 16. 21.
 CAPACITY= 0. 6. 34. 52. 89. 180. 312. 493.
 ELEVATION= 399. 410. 420. 430. 450. 460.

CHFL SPWFO COW EXPW ELEV COME CAREA EXPL
 466.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0

DAM DATA
 TOPPL COW EXPD DAMWID
 466.8 2.8 1.5 850.

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
 BOTTOM OF RESERVOIR ASSUMED TO BE AT 399.00
 STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 460.00

--STATION=000002, PLAN 1, RTIO 1
 END-OF-PERIOD HYDROGRAPH ORDINATES

PLATE D-7

SUVN®

WARNING *** TOP OF DAM, BOTTOM OF DREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA, () K.
 BOTTOM OF RESERVOIR ASSURED TO BE AT 399.00
 STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 460.00

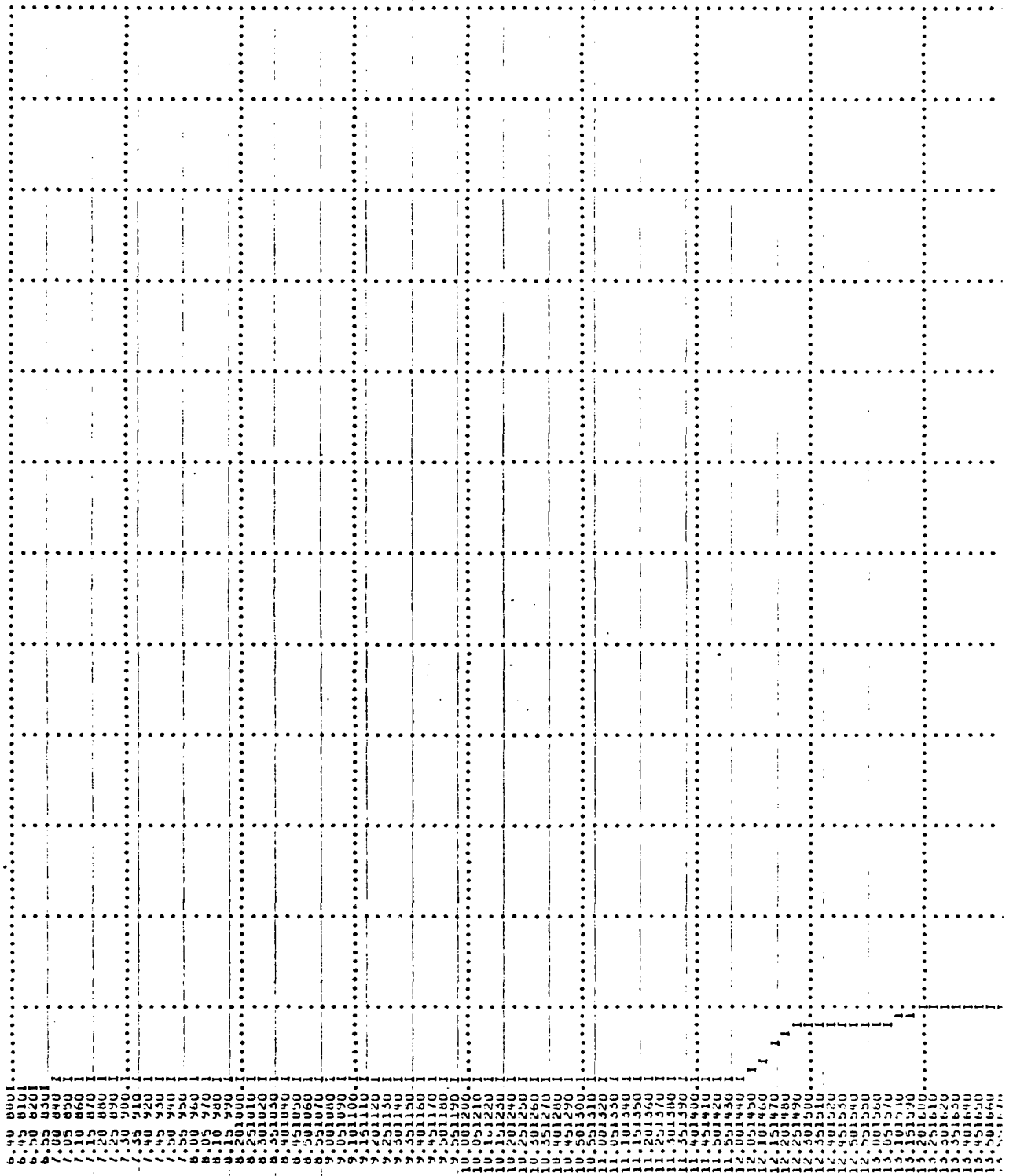
1/2 PMF

STATION 000002, PLAN 1, RATIO 4

ENU-OF-PERIOD HYDROGRAPH ORDINATES

OUTIL LOW

[illegible][illegible]



6.00 8001
6.05 8101
6.10 8201
6.15 8301
6.20 8401
6.25 8501
6.30 8601
6.35 8701
6.40 8801
6.45 8901
6.50 9001
6.55 9101
6.60 9201
6.65 9301
6.70 9401
6.75 9501
6.80 9601
6.85 9701
6.90 9801
6.95 9901
7.00 1000
7.05 1010
7.10 1020
7.15 1030
7.20 1040
7.25 1050
7.30 1060
7.35 1070
7.40 1080
7.45 1090
7.50 1100
7.55 1110
7.60 1120
7.65 1130
7.70 1140
7.75 1150
7.80 1160
7.85 1170
7.90 1180
7.95 1190
8.00 1200
8.05 1210
8.10 1220
8.15 1230
8.20 1240
8.25 1250
8.30 1260
8.35 1270
8.40 1280
8.45 1290
8.50 1300
8.55 1310
8.60 1320
8.65 1330
8.70 1340
8.75 1350
8.80 1360
8.85 1370
8.90 1380
8.95 1390
9.00 1400
9.05 1410
9.10 1420
9.15 1430
9.20 1440
9.25 1450
9.30 1460
9.35 1470
9.40 1480
9.45 1490
9.50 1500
9.55 1510
9.60 1520
9.65 1530
9.70 1540
9.75 1550
9.80 1560
9.85 1570
9.90 1580
9.95 1590
10.00 1600
10.05 1610
10.10 1620
10.15 1630
10.20 1640
10.25 1650
10.30 1660
10.35 1670
10.40 1680
10.45 1690
10.50 1700
10.55 1710
10.60 1720
10.65 1730
10.70 1740
10.75 1750
10.80 1760
10.85 1770
10.90 1780
10.95 1790
11.00 1800
11.05 1810
11.10 1820
11.15 1830
11.20 1840
11.25 1850
11.30 1860
11.35 1870
11.40 1880
11.45 1890
11.50 1900
11.55 1910
11.60 1920
11.65 1930
11.70 1940
11.75 1950
11.80 1960
11.85 1970
11.90 1980
11.95 1990
12.00 2000
12.05 2010
12.10 2020
12.15 2030
12.20 2040
12.25 2050
12.30 2060
12.35 2070
12.40 2080
12.45 2090
12.50 2100
12.55 2110
12.60 2120
12.65 2130
12.70 2140
12.75 2150
12.80 2160
12.85 2170
12.90 2180
12.95 2190
13.00 2200
13.05 2210
13.10 2220
13.15 2230
13.20 2240
13.25 2250
13.30 2260
13.35 2270
13.40 2280
13.45 2290
13.50 2300
13.55 2310
13.60 2320
13.65 2330
13.70 2340
13.75 2350
13.80 2360
13.85 2370
13.90 2380
13.95 2390
14.00 2400
14.05 2410
14.10 2420
14.15 2430
14.20 2440
14.25 2450
14.30 2460
14.35 2470
14.40 2480
14.45 2490
14.50 2500
14.55 2510
14.60 2520
14.65 2530
14.70 2540
14.75 2550
14.80 2560
14.85 2570
14.90 2580
14.95 2590
15.00 2600
15.05 2610
15.10 2620
15.15 2630
15.20 2640
15.25 2650
15.30 2660
15.35 2670
15.40 2680
15.45 2690
15.50 2700
15.55 2710
15.60 2720
15.65 2730
15.70 2740
15.75 2750
15.80 2760
15.85 2770
15.90 2780
15.95 2790
16.00 2800
16.05 2810
16.10 2820
16.15 2830
16.20 2840
16.25 2850
16.30 2860
16.35 2870
16.40 2880
16.45 2890
16.50 2900
16.55 2910
16.60 2920
16.65 2930
16.70 2940
16.75 2950
16.80 2960
16.85 2970
16.90 2980
16.95 2990
17.00 3000
17.05 3010
17.10 3020
17.15 3030
17.20 3040
17.25 3050
17.30 3060
17.35 3070
17.40 3080
17.45 3090
17.50 3100
17.55 3110
17.60 3120
17.65 3130
17.70 3140
17.75 3150
17.80 3160
17.85 3170
17.90 3180
17.95 3190
18.00 3200
18.05 3210
18.10 3220
18.15 3230
18.20 3240
18.25 3250
18.30 3260
18.35 3270
18.40 3280
18.45 3290
18.50 3300
18.55 3310
18.60 3320
18.65 3330
18.70 3340
18.75 3350
18.80 3360
18.85 3370
18.90 3380
18.95 3390
19.00 3400
19.05 3410
19.10 3420
19.15 3430
19.20 3440
19.25 3450
19.30 3460
19.35 3470
19.40 3480
19.45 3490
19.50 3500
19.55 3510
19.60 3520
19.65 3530
19.70 3540
19.75 3550
19.80 3560
19.85 3570
19.90 3580
19.95 3590
20.00 3600
20.05 3610
20.10 3620
20.15 3630
20.20 3640
20.25 3650
20.30 3660
20.35 3670
20.40 3680
20.45 3690
20.50 3700
20.55 3710
20.60 3720
20.65 3730
20.70 3740
20.75 3750
20.80 3760
20.85 3770
20.90 3780
20.95 3790
21.00 3800
21.05 3810
21.10 3820
21.15 3830
21.20 3840
21.25 3850
21.30 3860
21.35 3870
21.40 3880
21.45 3890
21.50 3900
21.55 3910
21.60 3920
21.65 3930
21.70 3940
21.75 3950
21.80 3960
21.85 3970
21.90 3980
21.95 3990
22.00 4000
22.05 4010
22.10 4020
22.15 4030
22.20 4040
22.25 4050
22.30 4060
22.35 4070
22.40 4080
22.45 4090
22.50 4100
22.55 4110
22.60 4120
22.65 4130
22.70 4140
22.75 4150
22.80 4160
22.85 4170
22.90 4180
22.95 4190
23.00 4200
23.05 4210
23.10 4220
23.15 4230
23.20 4240
23.25 4250
23.30 4260
23.35 4270
23.40 4280
23.45 4290
23.50 4300
23.55 4310
23.60 4320
23.65 4330
23.70 4340
23.75 4350
23.80 4360
23.85 4370
23.90 4380
23.95 4390
24.00 4400
24.05 4410
24.10 4420
24.15 4430
24.20 4440
24.25 4450
24.30 4460
24.35 4470
24.40 4480
24.45 4490
24.50 4500
24.55 4510
24.60 4520
24.65 4530
24.70 4540
24.75 4550
24.80 4560
24.85 4570
24.90 4580
24.95 4590
25.00 4600
25.05 4610
25.10 4620
25.15 4630
25.20 4640
25.25 4650
25.30 4660
25.35 4670
25.40 4680
25.45 4690
25.50 4700
25.55 4710
25.60 4720
25.65 4730
25.70 4740
25.75 4750
25.80 4760
25.85 4770
25.90 4780
25.95 4790
26.00 4800
26.05 4810
26.10 4820
26.15 4830
26.20 4840
26.25 4850
26.30 4860
26.35 4870
26.40 4880
26.45 4890
26.50 4900
26.55 4910
26.60 4920
26.65 4930
26.70 4940
26.75 4950
26.80 4960
26.85 4970
26.90 4980
26.95 4990
27.00 5000
27.05 5010
27.10 5020
27.15 5030
27.20 5040
27.25 5050
27.30 5060
27.35 5070
27.40 5080
27.45 5090
27.50 5100
27.55 5110
27.60 5120
27.65 5130
27.70 5140
27.75 5150
27.80 5160
27.85 5170
27.90 5180
27.95 5190
28.00 5200
28.05 5210
28.10 5220
28.15 5230
28.20 5240
28.25 5250
28.30 5260
28.35 5270
28.40 5280
28.45 5290
28.50 5300
28.55 5310
28.60 5320
28.65 5330
28.70 5340
28.75 5350
28.80 5360
28.85 5370
28.90 5380
28.95 5390
29.00 5400
29.05 5410
29.10 5420
29.15 5430
29.20 5440
29.25 5450
29.30 5460
29.35 5470
29.40 5480
29.45 5490
29.50 5500
29.55 5510
29.60 5520
29.65 5530
29.70 5540
29.75 5550
29.80 5560
29.85 5570
29.90 5580
29.95 5590
30.00 5600
30.05 5610
30.10 5620
30.15 5630
30.20 5640
30.25 5650
30.30 5660
30.35 5670
30.40 5680
30.45 5690
30.50 5700
30.55 5710
30.60 5720
30.65 5730
30.70 5740
30.75 5750
30.80 5760
30.85 5770
30.90 5780
30.95 5790
31.00 5800
31.05 5810
31.10 5820
31.15 5830
31.20 5840
31.25 5850
31.30 5860
31.35 5870
31.40 5880
31.45 5890
31.50 5900
31.55 5910
31.60 5920
31.65 5930
31.70 5940
31.75 5950
31.80 5960
31.85 5970
31.90 5980
31.95 5990
32.00 6000
32.05 6010
32.10 6020
32.15 6030
32.20 6040
32.25 6050
32.30 6060
32.35 6070
32.40 6080
32.45 6090
32.50 6100
32.55 6110
32.60 6120
32.65 6130
32.70 6140
32.75 6150
32.80 6160
32.85 6170
32.90 6180
32.95 6190
33.00 6200
33.05 6210
33.10 6220
33.15 6230
33.20 6240
33.25 6250
33.30 6260
33.35 6270
33.40 6280
33.45 6290
33.50 6300
33.55 6310
33.60 6320
33.65 6330
33.70 6340
33.75 6350
33.80 6360
33.85 6370
33.90 6380
33.95 6390
34.00 6400
34.05 6410
34.10 6420
34.15 6430
34.20 6440
34.25 6450
34.30 6460
34.35 6470
34.40 6480
34.45 6490
34.50 6500
34.55 6510
34.60 6520
34.65 6530
34.70 6540
34.75 6550
34.80 6560
34.85 6570
34.90 6580
34.95 6590
35.00 6600
35.05 6610
35.10 6620
35.15 6630
35.20 6640
35.25 6650
35.30 6660
35.35 6670
35.40 6680
35.45 6690
35.50 6700
35.55 6710
35.60 6720
35.65 6730
35.70 6740
35.75 6750
35.80 6760
35.85 6770
35.90 6780
35.95 6790
36.00 6800
36.05 6810
36.10 6820
36.15 6830
36.20 6840
36.25 6850
36.30 6860
36.35 6870
36.40 6880
36.45 6890
36.50 6900
36.55 6910
36.60 6920
36.65 6930
36.70 6940
36.75 6950
36.80 6960
36.85 6970
36.90 6980
36.95 6990
37.00 7000
37.05 7010
37.10 7020
37.15 7030
37.20 7040
37.25 7050
37.30 7060
37.35 7070
37.40 7080
37.45 7090
37.50 7100
37.55 7110
37.60 7120
37.65 7130
37.70 7140
37.75 7150
37.80 7160
37.85 7170
37.90 7180
37.95 7190
38.00 7200
38.05 7210
38.10 7220
38.15 7230
38.20 7240
38.25 7250
38.30 7260
38.35 7270
38.40 7280
38.45 7290
38.50 7300
38.55 7310
38.60 7320
38.65 7330
38.70 7340
38.75 7350
38.80 7360
38.85 7370
38.90 7380
38.95 7390
39.00 7400
39.05 7410
39.10 7420
39.15 7430
39.20 7440
39.25 7450
39.30 7460
39.35 7470
39.40 7480
39.45 7490
39.50 7500
39.55 7510
39.60 7520
39.65 7530
39.70 7540
39.75 7550
39.80 7560
39.85 7570
39.90 7580
39.95 7590
40.00 7600
40.05 7610
40.10 7620
40.15 7630
40.20 7640
40.25 7650
40.30 7660
40.35 7670
40.40 7680
40.45 7690
40.50 7700
40.55 7710
40.60 7720
40.65 7730
40.70 7740
40.75 7750
40.80 7760
40.85 7770
40.90 7780
40.95 7790
41.00 7800
41.05 7810
41.10 7820
41.15 7830
41.20 7840
41.25 7850
41.30 7860
41.35 7870
41.40 7880
41.45 7890
41.50 7900
41.55 7910
41.60 7920
41.65 7930
41.70 7940
41.75 7950
41.80 7960
41.85 7970
41.90 7980
41.95 7990
42.00 8000
42.05 8010
42.10 8020
42.15 8030
42.20 8040
42.25 8050
42.30 8060
42.35 8070
42.40 8080
42.45 8090
42.50 8100
42.55 8110
42.60 8120
42.65 8130
42.70 8140
42.75 8150
42.80 8160
42.85 8170
42.90 8180
42.95 8190
43.00 8200
43.05 8210
43.10 8220
43.15 8230
43.20 8240
43.25 8250
43.30 8260
43.35 8270
43.40 8280
43.45 8290
43.50 8300
43.55 8310
43.60 8320
43.65 8330
43.70 8340
43.75 8350
43.80 8360
43.85 8370
43.90 8380
43.95 8390
44.00 8400
44.05 8410
44.10 8420
44.15 8430
44.20 8440
44.25 8450
44.30 8460
44.35 8470
44.40 8480
44.45 8490
44.50 8500
44.55 8510
44.60 8520
44.65 8530
44.70 8540
44.75 8550
44.80 8560
44.85 8570
44.90 8580
44.95 8590
45.00 8600
45.05 8610
45.10 8620
45.15 8630
45.20 8640
45.25 8650
45.30 8660
45.35 8670
45.40 8680
45.45 8690
45.50 8700
45.55 8710
45.60 8720
45.65 8730
45.70 8740
45.75 8750
45.80 8760
45.85 8770
45.90 8780
45.95 8790
46.00 8800
46.05 8810
46.10 8820
46.15 8830
46.20 8840
46.25 8850
46.30 8860
46.35 8870
46.40 8880
46.45 8890
46.50 8900
46.55 8910
46.60 8920
46.65 8930
46.70 8940
46.75 8950
46.80 8960
46.85 8970
46.90 8980
46.95 8990
47.00 9000
47.05 9010
47.10 9020
47.15 9030
47.20 9040
47.25 9050
47.30 9060
47.35 9070
47.40 9080
47.45 9090
47.50 9100
47.55 9110
47.60 9120
47.65 9130
47.70 9140
47.75 9150
47.80 9160
47.85 9170
47.90 9180
47.95 9190
48.00 9200
48.05 9210
48.10 9220
48.15 9230
48.20 9240
48.25 9250
48.30 9260
48.35 9270
48.40 9280
48.45 9290
48.50 9300
48.55 9310
48.60 9320
48.65 9330
48.70 9340
48.75 9350
48.80 9360
48.85 9370
48.90 9380
48.95 9390
49.00 9400
49.05 9410
49.10 9420
49.15 9430
49.20 9440
49.25 9450
49.30 9460
49.35 9470
49.40 9480
49.45 9490
49.50 9500
49.55 9510
49.60 9520
49.65 9530
49.70 9540
49.75 9550
49.80 9560
49.85 9570
49.90 9580
49.95 9590
50.00 9600
50.05 9610
50.10 9620
50.15 9630
50.20 9640
50.25 9650
50.30 9660
50.35 9670
50.40 9680
50.45 9690
50.50 9700
50.55 9710
50.60 9720
50.65 9730
50.70 9740
50.75 9750
50.80 9760
50.85 9770
50.90 9780
50.95 9790
51.00 9800
51.05 9810
51.10 9820
51.15 9830
51.20 9840
51.25 9850
51.30 9860
51.35 9870
51.40 9880
51.45 9890
51.50 9900
51.55 9910
51.60 9920
51.65 9930
51.70 9940
51.75 9950
51.80 9960
51.85 9970
51.90 9980
51.95 9990
52.00 10000
52.05 10010
52.10 10020
52.15 10030
52.20 10040
52.25 10050
52.30 10060
52.35 10070
52.40 10080
52.45 10090
52.50 10100
52.55 10110
52.60 10120
52.65 10130
52.70 10140
52.75 10150
52.80 10160
52.85 10170
52.90 10180
52.95 10190
53.00 10200
53.05 10210
53.10 10220
53.15 10230
53.20 10240
53.25 10250
53.30 10260
53.35 10270
53.40 10280
53.45 10290
53.50 10300
53.55 10310
53.60 10320
53.65 10330
53.70 10340
53.75 10350
53.80 10360
53.85 10370
53.90 10380
53.95 10390
54.00 10400
54.05 10410
54.10 10420
54.15 10430
54.20 10440
54.25 10450
54.30 10460
54.35 10470
54.40 10480
54.45 10490
54.50 10500
54.55 10510
54.60 10520
54.65 10530
54.70 10540
54.75 10550
54.80 10560
54.85 10570
54.90 10580
54.95 10590
55.00 10600
55.05 10610
55.10 10620
55.15 10630
55.20 10640
55.25 10650
55.30 10660
55.35 10670
55.40 10680
55.45 10690
55.50 10700
55.55 10710
55.60 10720
55.65 10730
55.70 10740
55.75 10750
55.80 10760
55.85 10770
55.90 10780
55.95 10790
56.00 10800
56.05 10810
56.10 10820
56.15 10830
56.20 10840
56.25 10850
56.30 10860
56.35 10870
56.40 10880
56.45 10890
56.50 10900
56.55 10910
56.60 10920
56.65 10930
56.70 10940
56.75

001680
14 001690
14 001700
14 001710
14 001720
14 001730
14 001740
14 001750
14 001760
14 001770
14 001780
14 001790
15 001800
15 001810
15 001820
15 001830
15 001840
15 001850
15 001860
15 001870
15 001880
15 001890
15 001900
15 001910
15 001920
16 001930
16 001940
16 001950
16 001960
16 001970
16 001980
16 001990
16 002000
16 002010
16 002020
16 002030
16 002040
17 002050
17 002060
17 002070
17 002080
17 002090
17 002100
17 002110
17 002120
17 002130
17 002140
17 002150
18 002160
18 002170
18 002180
18 002190
18 002200
18 002210
18 002220
18 002230
18 002240
18 002250
18 002260
18 002270
19 002280
19 002290
19 002300
19 002310
19 002320
19 002330
19 002340
19 002350
19 002360
19 002370
19 002380
19 002390
20 002400
20 002410
20 002420
20 002430
20 002440
20 002450
20 002460
20 002470
20 002480
20 002490
20 002500
20 002510
21 002520
21 002530
21 002540
21 002550

PLATE D-12

PMF

STATION 000002, PLAN 1, RATIO 7
END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

| STORAGE | | | |
|---------|------|------|------|
| 177. | 177. | 177. | 177. |
| 177. | 177. | 177. | 177. |
| 177. | 177. | 177. | 177. |
| 177. | 177. | 177. | 177. |
| 177. | 177. | 177. | 177. |
| 178. | 178. | 178. | 178. |
| 178. | 178. | 178. | 178. |
| 178. | 178. | 178. | 178. |
| 179. | 179. | 179. | 179. |
| 181. | 181. | 182. | 182. |
| 184. | 184. | 186. | 186. |
| 187. | 187. | 188. | 188. |
| 190. | 190. | 191. | 191. |
| 193. | 193. | 194. | 194. |
| 196. | 197. | 198. | 198. |
| 203. | 205. | 207. | 208. |
| 215. | 218. | 219. | 221. |
| 229. | 231. | 233. | 236. |
| 247. | 249. | 250. | 254. |
| 296. | 299. | 300. | 304. |
| 317. | 319. | 320. | 322. |
| 335. | 336. | 337. | 338. |
| 342. | 343. | 344. | 345. |
| 343. | 344. | 345. | 346. |
| 344. | 345. | 346. | 347. |
| 346. | 347. | 348. | 349. |
| 348. | 349. | 350. | 351. |
| 351. | 352. | 353. | 354. |
| 352. | 353. | 354. | 355. |
| 353. | 354. | 355. | 356. |
| 354. | 355. | 356. | 357. |
| 356. | 357. | 358. | 359. |
| 358. | 359. | 360. | 361. |
| 361. | 362. | 363. | 364. |
| 362. | 363. | 364. | 365. |
| 363. | 364. | 365. | 366. |
| 364. | 365. | 366. | 367. |
| 366. | 367. | 368. | 369. |
| 368. | 369. | 370. | 371. |
| 371. | 372. | 373. | 374. |
| 372. | 373. | 374. | 375. |
| 373. | 374. | 375. | 376. |
| 374. | 375. | 376. | 377. |
| 376. | 377. | 378. | 379. |
| 378. | 379. | 380. | 381. |
| 381. | 382. | 383. | 384. |
| 382. | 383. | 384. | 385. |
| 383. | 384. | 385. | 386. |
| 384. | 385. | 386. | 387. |
| 386. | 387. | 388. | 389. |
| 388. | 389. | 390. | 391. |
| 391. | 392. | 393. | 394. |
| 392. | 393. | 394. | 395. |
| 393. | 394. | 395. | 396. |
| 394. | 395. | 396. | 397. |
| 396. | 397. | 398. | 399. |
| 398. | 399. | 400. | 401. |
| 401. | 402. | 403. | 404. |
| 402. | 403. | 404. | 405. |
| 403. | 404. | 405. | 406. |
| 404. | 405. | 406. | 407. |
| 406. | 407. | 408. | 409. |
| 408. | 409. | 410. | 411. |
| 411. | 412. | 413. | 414. |
| 412. | 413. | 414. | 415. |
| 413. | 414. | 415. | 416. |
| 414. | 415. | 416. | 417. |
| 416. | 417. | 418. | 419. |
| 418. | 419. | 420. | 421. |
| 421. | 422. | 423. | 424. |
| 422. | 423. | 424. | 425. |
| 423. | 424. | 425. | 426. |
| 424. | 425. | 426. | 427. |
| 426. | 427. | 428. | 429. |
| 428. | 429. | 430. | 431. |
| 431. | 432. | 433. | 434. |
| 432. | 433. | 434. | 435. |
| 433. | 434. | 435. | 436. |
| 434. | 435. | 436. | 437. |
| 436. | 437. | 438. | 439. |
| 438. | 439. | 440. | 441. |
| 441. | 442. | 443. | 444. |
| 442. | 443. | 444. | 445. |
| 443. | 444. | 445. | 446. |
| 444. | 445. | 446. | 447. |
| 446. | 447. | 448. | 449. |
| 448. | 449. | 450. | 451. |
| 451. | 452. | 453. | 454. |
| 452. | 453. | 454. | 455. |
| 453. | 454. | 455. | 456. |
| 454. | 455. | 456. | 457. |
| 456. | 457. | 458. | 459. |
| 458. | 459. | 460. | 461. |
| 461. | 462. | 463. | 464. |
| 462. | 463. | 464. | 465. |
| 463. | 464. | 465. | 466. |
| 464. | 465. | 466. | 467. |
| 466. | 467. | 468. | 469. |
| 468. | 469. | 470. | 471. |
| 471. | 472. | 473. | 474. |
| 472. | 473. | 474. | 475. |
| 473. | 474. | 475. | 476. |
| 474. | 475. | 476. | 477. |
| 476. | 477. | 478. | 479. |
| 478. | 479. | 480. | 481. |
| 481. | 482. | 483. | 484. |
| 482. | 483. | 484. | 485. |
| 483. | 484. | 485. | 486. |
| 484. | 485. | 486. | 487. |
| 486. | 487. | 488. | 4 |

[illegible]

CONFIDENTIAL

SIAT10N00002

[illegible]

PLATE D-16

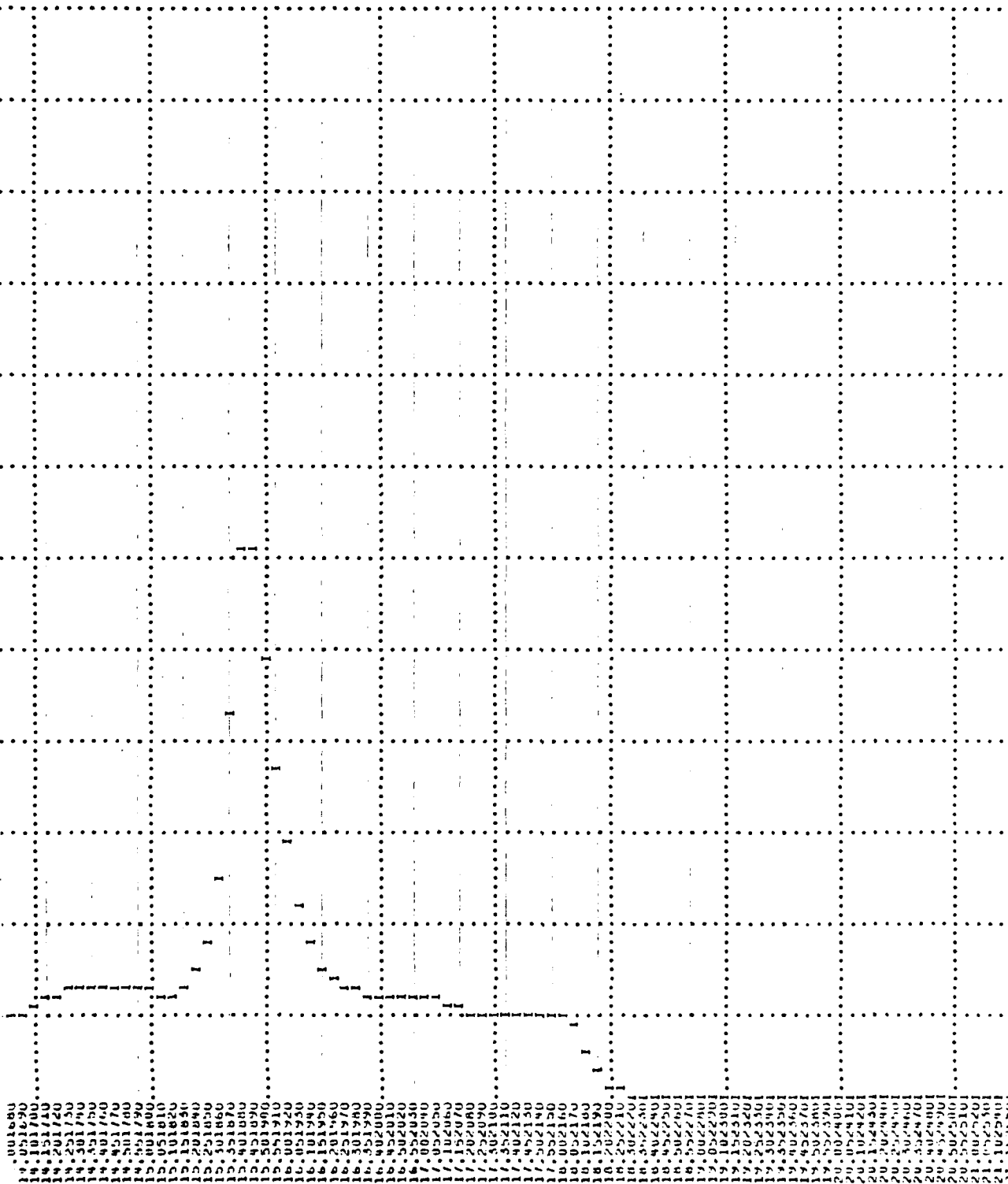


PLATE D-18

1088200 n
1078800
1068200
1058200
1048200
1038200
1028200
1018200
1008200
998200
988200
978200
968200
958200
948200
938200
928200
918200
908200
898200
888200
878200
868200
858200
848200
838200
828200
818200
808200
798200
788200
778200
768200
758200
748200
738200
728200
718200
708200
698200
688200
678200
668200
658200
648200
638200
628200
618200
608200
598200
588200
578200
568200
558200
548200
538200
528200
518200
508200
498200
488200
478200
468200
458200
448200
438200
428200
418200
408200
398200
388200
378200
368200
358200
348200
338200
328200
318200
308200
298200
288200
278200
268200
258200
248200
238200
228200
218200
208200
198200
188200
178200
168200
158200
148200
138200
128200
118200
108200
98200
97200
96200
95200
94200
93200
92200
91200
90200
89200
88200
87200
86200
85200
84200
83200
82200
81200
80200
79200
78200
77200
76200
75200
74200
73200
72200
71200
70200
69200
68200
67200
66200
65200
64200
63200
62200
61200
60200
59200
58200
57200
56200
55200
54200
53200
52200
51200
50200
49200
48200
47200
46200
45200
44200
43200
42200
41200
40200
39200
38200
37200
36200
35200
34200
33200
32200
31200
30200
29200
28200
27200
26200
25200
24200
23200
22200
21200
20200
19200
18200
17200
16200
15200
14200
13200
12200
11200
10200
9200
8200
7200
6200
5200
4200
3200
2200
1200
200
0

PLAN FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC FEET PER SECOND)
 AREA IN SQUARE FEET (SQUARE KILOMETERS)

| OPERATION | STATION | AREA | PLAN | RATIOS APPLIED TO FLOWS | | | | | | | | | |
|---------------|---------|--------------|------|-------------------------|---------------|----------------|----------------|----------------|----------------|-----------------|--|--|--|
| | | | | RATIO 1 | RATIO 2 | RATIO 3 | RATIO 4 | RATIO 5 | RATIO 6 | RATIO 7 | | | |
| HYDROGRAPH AT | UUUU01 | .10 (.26) | 1 | 123 (5.40) | 246 (6.95) | 491 (13.91) | 614 (17.38) | 737 (20.86) | 982 (27.82) | 1228 (34.77) | | | |
| | UUUU02 | .10 (.26) | 1 | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | | | |

SUMMARY OF DAM SAFETY ANALYSIS

| PLAN 1 | ELEVATION STORAGE OUTFLOW | INITIAL VALUE 439.80 177. 0. | SPILLWAY CREST 466.80 650. 0. | TOP OF DAM 466.80 650. 0. | | | |
|--------------------|----------------------------------|---------------------------------------|--|------------------------------------|-------------------------------|---------------------------------|-----------------------------|
| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
| .10 | 441.42 | 0.00 | 192. | 0. | 0.00 | 0.00 | 0.00 |
| .20 | 442.72 | 0.00 | 212. | 0. | 0.00 | 0.00 | 0.00 |
| .30 | 443.44 | 0.00 | 246. | 0. | 0.00 | 0.00 | 0.00 |
| .40 | 444.69 | 0.00 | 263. | 0. | 0.00 | 0.00 | 0.00 |
| .50 | 446.50 | 0.00 | 280. | 0. | 0.00 | 0.00 | 0.00 |
| .60 | 447.90 | 0.00 | 314. | 0. | 0.00 | 0.00 | 0.00 |
| .70 | 450.17 | 0.00 | 348. | 0. | 0.00 | 0.00 | 0.00 |
| .80 | 452.29 | 0.00 | 348. | 0. | 0.00 | 0.00 | 0.00 |
| 1.00 | | | | | | | |

APPENDIX E
PRELIMINARY SLOPE STABILITY ANALYSES

PRELIMINARY SLOPE STABILITY ANALYSES

The Simplified Bishop Method was used. Computations were based on the following assumptions:

- Phreatic line developed from elevation 452 (PMF) to downstream slope elevation of 415.
- Embankment dry unit weight - 100 pcf.
- $\bar{\phi} = 30^{\circ}$
- $\bar{c} = 300$ psf
- Embankment height = 75 feet at elevation 473.
- Foundation 10 feet deep having same properties as the embankment and underlain by bedrock.

The results of the preliminary analysis are as shown in the table below:

| <u>Section</u> | <u>Factor of Safety</u> | | <u>Factor of Safety</u> | |
|----------------|-------------------------|-----------------|-------------------------|-----------------|
| | <u>Computed</u> | <u>Required</u> | <u>Computed</u> | <u>Required</u> |
| Overall | 1.92 | 1.5 | 1.01 | 1.0 |
| Below Berm | 1.72 | 1.5 | 1.06 | 1.0 |

Plate E-2 summarizes the results of the analyses.

minimum
 $FS = 1.02$
 $FS = 1.01$ with $AE = 0.15g$

minimum
 $FS = 1.72$
 $FS = 1.06$ with $AE = 0.15g$

90°
 308

$AE = 110.957$
 $\theta = 90^\circ$
 $E = 300,000$

